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Voltage Stability by using Load Flow Analysis

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Abstract

Control framework steadiness infers that its capacity to come back to typical or stable operation in the wake of having been subjected to some from of unsettling influence. The transmission systems should be utilized always effectively. The exchange limits of a current transmission arrange should be expanded without real speculations additionally without trading off the security of the power framework. The more proficient utilization of transmission system has as of now prompted to a circumstance in which numerous power frameworks are worked all the more frequently and longer near voltage strength limits.

Keywords: *Load Flow Analysis, Force Framework Solidness, Voltage Stability.*

1. Introduction

The principle goal of this paper is Improving the voltage size at the transports when the voltage diminish with expanding the heap. The issue of this paper of un strength of the voltages at transports when a few burdens enter or leave our energy framework found that the voltage in a few transports will be powerless so we have to expand the voltage at these transports. We Use in this paper the technique for infusion the transports feeble by receptive power. The transport voltage greatness increment as the responsive power infusion at same transport is expanded, The transport voltage extent diminish as the receptive power infusion (Q) at same transport expanded[1]. Completing burden stream examination for a 14 transports by (MATLAB) and we realize that the feeble transport of the framework and we make an infusion by a capacitors to enhance the voltage size at this transports[2]. There are a few reasons make the administration of force frameworks more troublesome than prior, for example, because of expanded rivalry existing force frameworks are required to give more noteworthy benefit or deliver a similar administration at lower costs, ecological limitations extremely confine the development of a transmission arrange, in a deregulated showcase there is a requirement for another sort of voltage and power stream control (for which existing force frameworks are not intended for), the transmission limit with respect to all exchanges in the open get to systems should be resolved and less administrators are occupied with the supervision and operation of force systems[1].

In spite of the fact that power creation, transmission and dispersion are unbundled there still exist basic interests for these organizations: control framework ampleness and security. The sufficiency of generation and transmission limit is kept up in the long haul and is identified with power framework arranging. The security of a power framework is identified with power framework operation. The security of a power framework is a compulsory open great vital for trust in the power advertise. To keep up a safe framework, the framework administrator needs available to him different administrations called subordinate administrations from era and significant clients [2]. A power framework focused by overwhelming stacking has a considerably extraordinary reaction to unsettling influences from that of a non-focused on framework. The potential size and impact of aggravations has additionally expanded: When a power framework is worked more like a security farthest point, a generally little unsettling influence may bring about a framework irritate. Moreover, larger areas of the interconnected framework might be influenced by an aggravation[3].

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Precariousness implies a condition indicating loss of synchronism of synchronous machines or dropping out of venture therefore the condition of harmony or dependability of a power framework to keeping up synchronous working of the system[3].

2. Voltage Stability

Voltage soundness is an issue in power frameworks which are intensely stacked, blamed or have a deficiency of responsive power. The way of voltage security can be broke down by inspecting the generation, transmission and utilization of receptive power. The issue of voltage dependability concerns the entire power framework, in spite of the fact that it typically has a huge contribution in one basic region of the power system[3].

2.1 Classification of Force Framework Solidness

Control framework solidness is arranged above as rotor edge and voltage security. An order of force framework solidness in view of time scale and main thrust criteria is introduced. The main impetuses for an insecurity component are named generator-driven and stack driven. It ought to be noticed that these terms don't bar the effect of different parts to the instrument. The time scale is separated into short and long haul time scales[3].

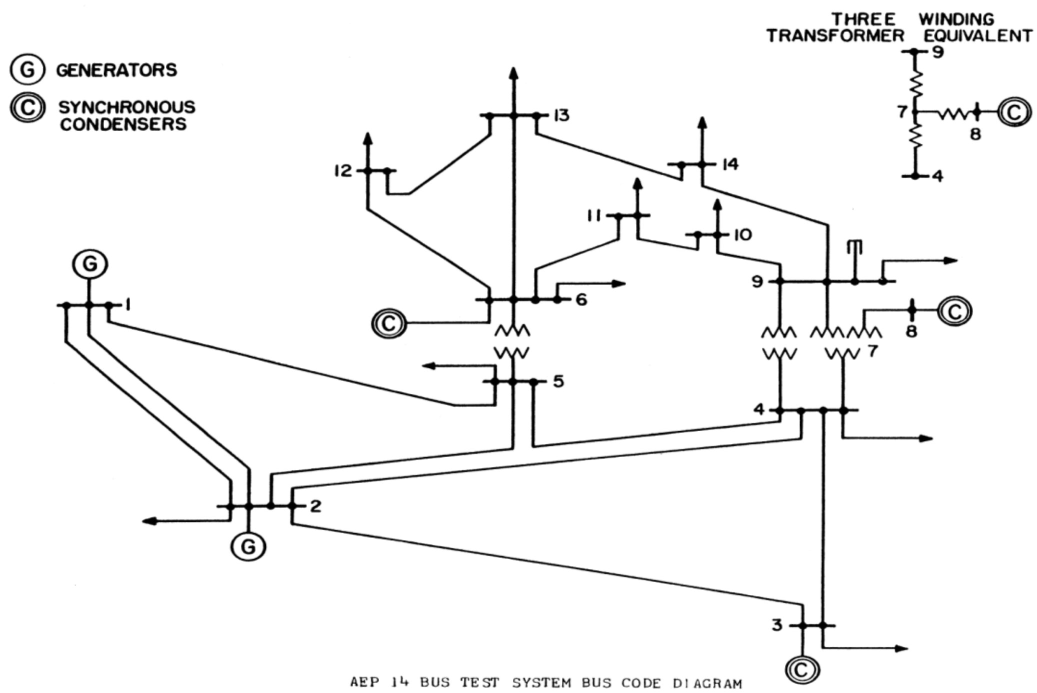

Figure 2.1: Single Diagram IEEE-14 Bus

The motivation behind the paper is to figure the heap voltage with various estimations of load. The heap voltage can be figured by load-stream program. The arrangements of load voltages are frequently introduced as a PV-bend (see Figure2.2).The PV-bend presents stack voltage as an element of load or whole ofloads. It presents both arrangements of force framework. Control frameworks are worked in the upper part of the PV-bend. This part of the PV-bend is statically and powerfully steady.

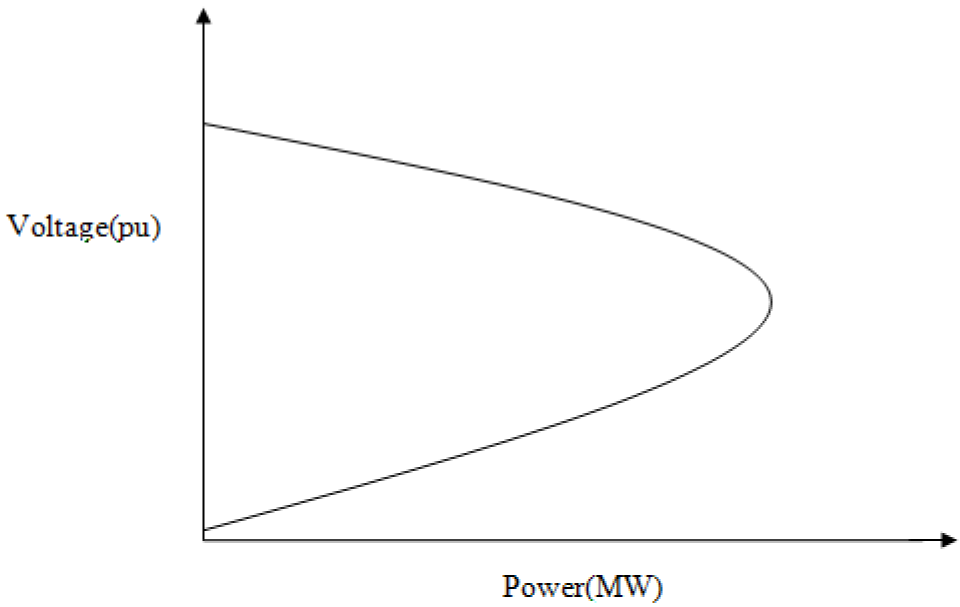

Figure 2.2: Voltage against Load

3. Power System Models

3.1 Transmission Line Models

$$V_S = AV_R + BI_R \text{ Volts} \ldots \ldots \ldots (3.1)$$

$$I_S = CV_R + DI_R \text{ Amp} \ldots \ldots \ldots (3.2)$$

Or, in matrix form,

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \ldots \ldots \ldots (3.3)$$

A,B,C and D are the parameters that depend on the transmission-line constants R, L,C and G. the ABCD parameters are , in general, complex numbers. A and D are dimensionless. B has units of ohms and C has units of Siemens.

Also the following identify holds for ABCD constants.

$$AD - BC = 1$$

To avoid confusion between total series impedance and series impedance per unit length the following national is used.

$$z = R + j\omega L$$

Ω/m, *series impedance per unit lenght*

$$y = G + j\omega C$$

S/m, , *series impedance per unit lenght*

$Z = zl\ \Omega$, total series impedance

$Y = yl\ S$, total shunt admiitance

$l =$ *line length, m.*

Note that the shunt conductance G is usually neglected for overhead transmission system[2].

3.1.1 Short Transmission Line

Capacitance might be disregarded without much mistake if the lines are under 80km long or if the voltage is not more than 66 kV. The short line display on per-stage premise is appeared in Fig. 3.1. Characteristics and performance of transmission lines

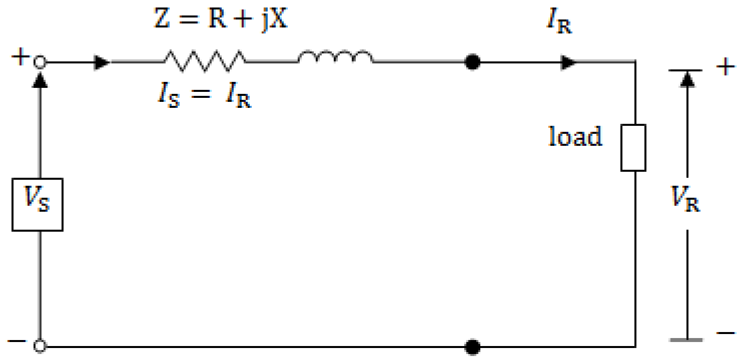

Fig. 3.1: Short Line Model

This is a straightforward arrangement circuit. The relationship between sending end voltages and streams can be composed as:

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} I & Z \\ 0 & I \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \dots\dots\dots(3.4)$$

The phasor diagram for the short-line is shown in Fig. 3.2 for lagging load current.
From Fig. 3.2, we can write

$$|V_S|\cos(\delta_S - \delta_R) = |I|R\cos\delta_R + |I|X\sin\delta_R + |V_R| \dots\dots\dots\dots\dots(3.5)$$

$(\delta_S - \delta_R)$ is very small, $\cos(\delta_S - \delta_R) = 1.0$

$$|V_S| = |V_R| + |I|(R\cos\delta_R + X\sin\delta_R) \dots\dots\dots(3.6)$$

Equation (3.6) is quite accurate for the normal range of load

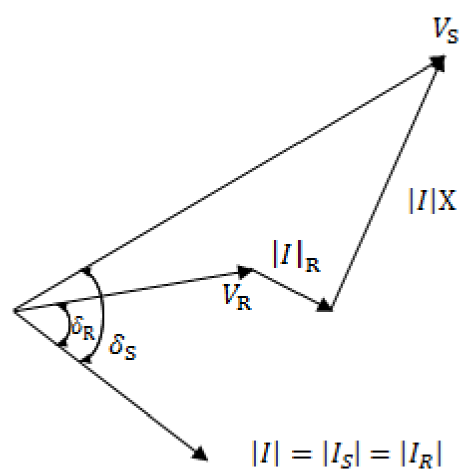

Fig. 3.2: Phasor Diagram

3.1.2 Medium Transmission Line

For the lines more than 80km long and beneath 250 km in lengths are dealt with as medium lengths lines, and the line charging current gets to be obvious and the shunt capacitance must be considered. For, medium lengths lines, half of the shunt capacitance might be thought to be lumped at every end of the line. This is alluded to as the ostensible π demonstrate as appeared in Fig. 3.3.

The sending end voltage and current for the ostensible π model are gotten as follows[4]

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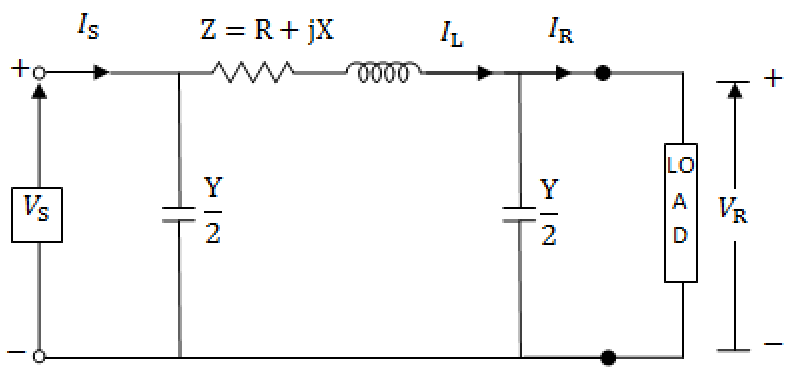

Figure 3.3: Medium Length Line, Nominal π Representation

From KCL, the current in the series impedance designated by I_L is

$$I_L = I_R + \frac{Y}{2} V_R \text{ ... ... } (3.7)$$

From KVL, the sending end voltage is

$$V_s = V_R + ZI_L \text{ ... ... } (3.8)$$

From eqns. (3.7), and (3.8), w get,

$$V_S = \left(1 + \frac{ZY}{2}\right) V_R + ZI_R \text{ ... ... } (3.9)$$

The sending end current is,

$$I_S = I_L + \frac{Y}{2} V_S \text{ ... ... } (3.10)$$

From eqns. (3.10), (3.9) ad (3.7) we get,

$$I_S = Y\left(1 + \frac{ZY}{4}\right) V_R + \left(1 + \frac{ZY}{2}\right) I_R \text{ ... ... } (3.11)$$

Eqns (3.9) and (3.11) can be written matrix form.

$$\begin{bmatrix} V_S \\ I_S \end{bmatrix} = \begin{bmatrix} \left(1 + \frac{ZY}{2}\right) & Z \\ Y\left(1 + \frac{ZY}{4}\right) & \left(1 + \frac{ZY}{2}\right) \end{bmatrix} \begin{bmatrix} V_R \\ I_R \end{bmatrix} \text{ ... ... } (3.12)$$

Therefore, the ABCD constants for the nominal π model are given by

$$A = \left(1 + \frac{ZY}{2}\right), B = z,$$

$$C = Y\left(1 + \frac{ZY}{4}\right), D = \left(1 + \frac{ZY}{2}\right)$$

3.1.3 Long Transmission Line

For short and medium length lines, exact models were acquired by accepting the line parameters to be lumped. On the off chance that the lines are more than 250 km long, for precise arrangements the parameters must be taken as appropriated consistently along the length as an aftereffect of which the voltages and streams will differ from indicate point on hold. In this area, expressions for voltage and current anytime on hold are inferred. At that point, in light of these conditions, an equal π model is gotten for long transmission line[4]. Figure 3.4 shows one period of a conveyed line of length l km.

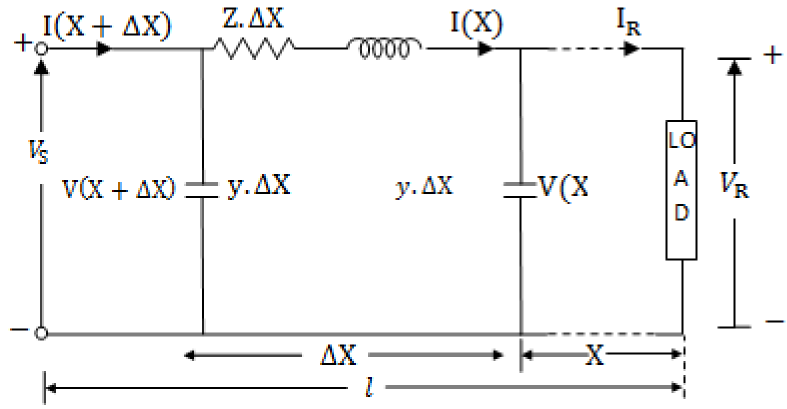

Figure 3.4: Schematic Diagram of a Long Transmission Line with Distributed Parameters

4. Load Flow

4.1 Introduction

Stack stream investigation is likely the most essential of all system estimations since it concerns the system execution in its typical working conditions. It is performed to explore the extent and stage edge of the voltage at every transport and the genuine and responsive power streams in the framework segments[4]. Stack how examination has an incredible significance in future extension arranging, in security concentrates on and in deciding the best efficient operation for existing frameworks. Likewise stack stream results are extremely important for setting the best possible assurance gadgets to guarantee the security of the S stern, keeping in mind the end goal to play out a heap stream consider. Full information must be given about the concentrated on framework, for example, association outline parameters of transformer and lines, evaluated values every gear, and the accepted estimations of genuine and receptive power for each load[4].

4.2 Solution of Nonlinear Algebraic Equations

The most well-known strategies utilized for the iterative arrangement of nonlinear logarithmic conditions are Gauss-Seidel, Newton-Raphson, and Quasi-Newton techniques. The Gauss-Seidel and Newton-Raphson strategies are examined for one-dimensional condition, and are then stretched out to n-dimensional conditions [5].

4.2.1 Newton-Raphson Method

The most broadly utilized strategy for illuminating concurrent nonlinear arithmetical conditions is the Newton-Raphson technique. Newton's strategy is a progressive surmised particle system in light of an underlying appraisal of the obscure and the utilization of Taylor's arrangement development. Consider the arrangement of the one-dimensional condition given by

f(x)=c……………………………………..…(4.1)

If $x^{(0)}$ is an initial estimate of the solution, and $\Delta x^{(0)}$ is a small deviation from the correct solution, we must have

$$f\left(x^{(0)} + \Delta x^{(0)}\right) = c$$

Expanding the left-hand side of the above equation in Taylor's series about yields

$$f\left(x^{(0)}\right) + \left(\frac{df}{dx}\right)^{(0)} \Delta x^{(0)} + \frac{1}{2!}\left(\frac{d^2f}{dx^2}\right)^{(0)} \left(\Delta x^{(0)}\right)^2 + .. = c$$

Assuming the error $\Delta x^{(0)}$ is very small, the higher-order terms can be neglected, which results in

$$\Delta c^{(0)} \approx \left(\frac{df}{dx}\right)^{0} \Delta x^{(0)}$$

Where

$$\Delta c^{(0)} = c - f\left(x^{(0)}\right)$$

Adding $\Delta x^{(0)}$ to the initial estimate will result in the second pproximation

$$x^{(1)} = \Delta x^{(0)} + \frac{\Delta c^{(0)}}{\left(\frac{df}{dx}\right)^{0}}$$

Successive use of this procedures yields the Netwton-Raphson algorithm

$$\Delta c^{(k)} = c - f\left(x^{(k)}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (4.2)$$

$$\Delta x^{(k)} = \frac{\Delta c^{(k)}}{\left(\frac{df}{dx}\right)^{(k)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4.3)$$

$$x^{(k+1)} = x^{(k)} + \Delta x^{(k)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (4.4)$$

(4.3) can be rearranged as

$$\Delta c^{(k)} = j^{(k)} \Delta x^{(k)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . \quad (4.5)$$

Where

$$j^{(k)} = \left(\frac{df}{dx}\right)^{(k)}$$

The relation in (4.5) demonstrates that the nonlinear equation f(x) - c = 0 is approximated by the tangent line on the curve at x(c). Therefore, a linear equation is obtained in terms of the small changes in the variable. The intersection of the tangent line with the x-axis results in $x^{(k)}$

5. Results and Discussion

In the next we discuss the results of power flow analysis by Newton Raphson method for IEEE -14bus at increasing the load and study affect that in bus voltage to detect weak bus. In this case carrying out load flow analysis and calculate the buses voltages, angles and power generation.

Power Flow Solution by Newton-Raphson Method

Maximum Power Mismatch = 0.000731858

No. of Iterations = 3

Table 5.1: Results of Power Flow Analysis by Newton Raphson Method for IEEE -14bus

Bus	Case(1)	Case(2)	Case(3)	Case(4)
No	voltage (pu)	Voltage(pu)	Voltage(pu)	Voltage(pu)
1	1.060	1.060	1.060	1.060
2	1.045	1.045	1.045	1.045
3	1.010	0.980	0.960	0.960
4	1.019	0.984	0.889	0.739
5	1.022	0.989	0.893	0.727
6	1.070	1.020	1.020	1.020
7	1.061	1.016	0.926	0.808
8	1.090	1.060	1.040	1.040
9	1.055	0.997	0.880	0.731

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10	1.050	0.989	0.878	0.742
11	1.056	0.999	0.936	0.862
12	1.055	0.996	0.962	0.932
13	1.050	0.988	0.937	0.888
14	1.035	0.964	0.836	0.689

*All cases(1,2,3and 4) the weak bus is bus No(14) and less voltage can be received without the network losing balance state is(0.689)
*can drawing relationship between Load and bus voltage, taking bus no
(14) For example:

Table 5.2: Relationship between Power and Bus Voltage

POWER MW	0	14.7	22.35	29.8	37.25	44.7	52.15	57.365
VOLTAGE PU	1.048	1.035	0.964	0.924	0.884	0.836	0.771	0.689

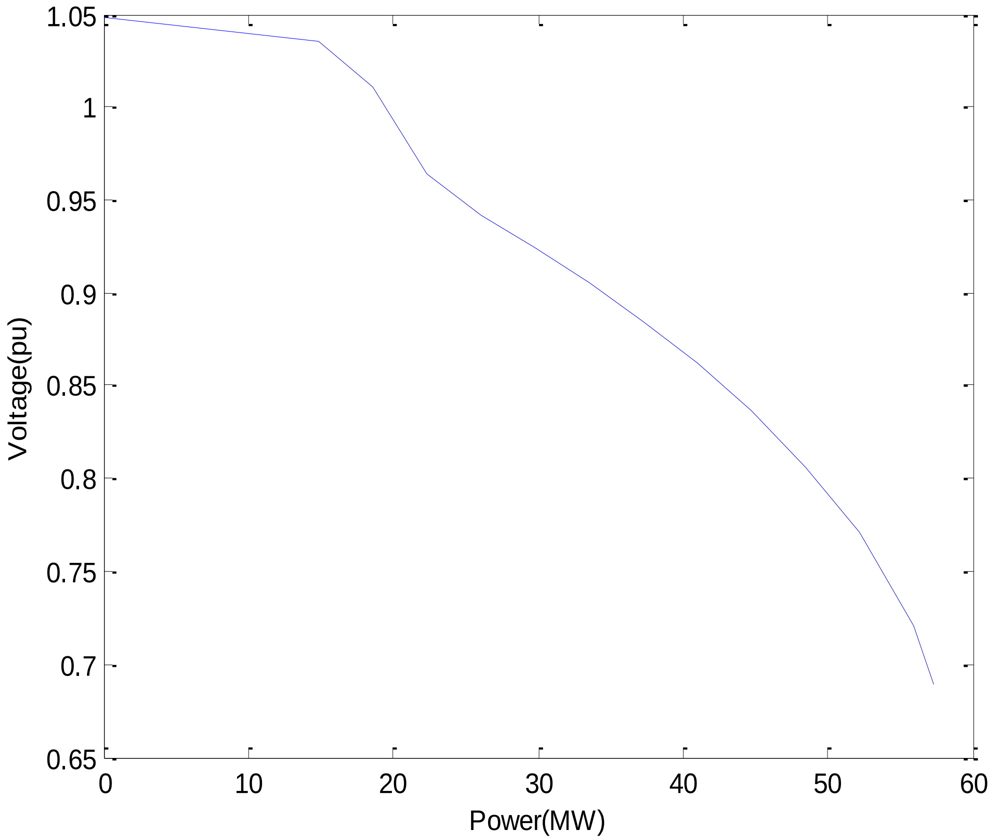

Figure 5.1: Voltage against Load

6. Conclusion

From this paper found that the voltage soundness is critical in power frameworks additionally found that the heap stream investigation has an extraordinary significance in future development arranging and in steadiness contemplates.

In our outcomes and talk about in the wake of completing burden stream investigation and expanding the heap at the power framework at three times 1.5 and 2.5 and 3.85 and we quit expanding the heap to dodge voltage caved in , observed that while expanding the heap in the system, voltage greatness will diminish at the transports (exceptional the transports a long way from era).

Additionally found that when infusion receptive power at the feeble transports the voltage greatness will increment.

This shunt capacitor is perfect strategy to enhance the voltage in power framework.

7. Recommendation

*Establish generation station near the weak buses
* Equilibrium distribution for loads
* Increasing generation sources
*Using other methods in future for voltage stability such as faxed Capacitor method.

References

[1] Sami ropi, Doctor Philosophy "One –line voltage stability assessment of power system-An approach of Black box" - Copyright ©2001.
[2] D.DAS "Electrical Power Systems" - Copyright © 2006, New Age International (P) Ltd., Publishers Published by New Age International (P) Ltd., Publishers
[3] Hadi Saddat "Power system Analysis" Mc Graw– hill, Milwaukee school of engineering New York, 1999.
[4] P. Cundur "Power System Stability and Control".
[5] IEEE (WWW.IEEE.COM).